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ABSTRACT

This study investigates the extent of participation in science learning activities of rural students and their science achievement compared to students in other schools based on 1982 National Assessment of Educational Progress (NAEP) data. The students living in extreme rural America have less opportunity to learn science than their large city counterparts. They are less likely to have experimented with things, or participated in informal science activities. They have taken fewer science courses. Results reported were similar for both 13- and 17-year-old students. Meanings of the results are discussed. Four references are listed. A study examining the status of science education in the rural midwest is reported in the appendix. The results for the midwestern study were similar to those found in the national study. (YP)

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SCIENCE EDUCATION IN RURAL AMERICA

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Prepared for the
North Central Regional Educational Laboratory

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Science Education in the Rural Midwest

Introduction

For many years, rural schools have been a neglected component of American education. This is in spite of the fact that small schools enroll between 20 and 25 percent of the elementary- and secondary-school population and their numbers represent more than half of the nation's school districts. (Stephens, 1987). However, recent pressures on rural schools, for example, changes in enrollment patterns and erosion of their economic support base due to declines in the value of farm land, have sensitized policy makers to the need to better understand the condition of rural education across the nation. Information is needed in order to establish and implement effective policy initiatives to ensure that quality schooling is available to children living in rural areas. The need is particularly great in science as our nation attempts to enhance teaching and learning in these areas to prepare our students for an increasingly complex scientific and technological society.

Little is known about the current status of science education in rural America. Results of national assessments conducted during the 1970s revealed that rural students performed below their counterparts living in larger areas although the gap narrowed during the decade. Whether or not this trend has continued into the 1980s is unknown. The reasons for the discrepancies are unclear, but one factor may be the lack of adequate opportunities to learn science. Rural students may not have the chances to participate in those activities that lead to science learning, for example, taking science courses in school or becoming involved in science or science-related activities outside of school.

Information on the extent of science participation among students in rural schools is limited, at least among national samples. In addition, the achievement of rural students has not been reported since the 1976-77 assessment. The most recent national assessment in science for which data are currently available (Hueftle, Rakow, and Welch, 1983) provides an opportunity to address these gaps in our knowledge. National data were gathered on student participation and science achievement for both 13- and 17-year-olds. In addition, the sampling plan included representation from schools in communities described as rural, making it possible to compare the participation and achievement of rural students with students attending larger schools.

The specific problems of this study are to determine:

1. the extent of participation in science learning activities of rural students compared to students in other American schools

2. the science achievement of students in rural schools compared to students in other schools

Procedures

National Assessment in Science

The National Assessment of Educational Progress (NAEP) was established in 1969 to assess periodically students' knowledge of various school subjects. National assessments in science were conducted by the Education Commission of the States in 1970, 1973, and 1977. However, legislative decisions and financial constraints caused the National Institute of Education to postpone the next scheduled science assessment until the late

1980s. Because of concerns over the long interval between scheduled assessments, the National Science Foundation funded a study to fill this void. A grant was made to the University of Minnesota to collect science achievement data in 1982 along with additional information on attitudes and participation as well as many characteristics of the home, community, and school (Hueftle, Rakow, and Welch, 1983). (A subsequent science assessment was conducted by Educational Testing Service in 1986. However, the results of that study have not been published and current plans do not call for them to report the achievement of rural students.)

The 1982 science assessment involved a national sample of approximately 16,000 students of ages 13 and 17 selected from about 540 schools in the United States. Random samples of approximately 2,000 children were selected to respond to a set of questions contained in a test booklet that required about 45 minutes of testing time. Each booklet contained a set of achievement, attitude, and background items. Several of the attitude items and one background question addressed the issue of science participation. The achievement and participation information gathered from eight test booklets administered to 13- and 17-year-olds (four at each age level) was used to address the problems of this study.

Achievement and Participation Measures

The 1982 assessment consisted of four categories of items: (1) science content, the body of scientific knowledge; (2) science inquiry, the processes by which the knowledge base is derived; (3) science, technology, and society (STS), the implications of the knowledge base for mankind; and (4) attitudes, the orientation and feeling students have toward science. Each test booklet contained items from three of the four categories and various combinations were used so that each category appeared in three booklets. In addition, a question on science course-taking appeared in every booklet.

The achievement tests given at ages 13 and 17 were similar and contained the following number and category of items. Many items were dual coded, because they were judged to be measures of more than one category. Thus, the category labels are not unique definitions but descriptive of the type of items included in each booklet.

Booklet S/T20 - 73 items; Content, Inquiry, STS
Booklet S/T21 - S-49 items, T-53 items; Inquiry, STS
Booklet S/T22 - 49 items; Content, STS
Booklet S/T23 - 35 items; Inquiry, Content

S refers to booklets given to 17-year-olds; T refers to booklets given to 13-year-olds. A total of 210 achievement items were used in the present study. Additional information on the nature of the NAEP items may be found in Hueftle, Rakow, and Welch (1983).

The measures of science participation used in this study included self-reports of participation in out-of-school or informal science learning activities and the number of science courses studied. The measure of courses taken differed for the two age levels. At age 17, it was the number of semesters studied in general science, biology, chemistry, and physics in grades 9-12. At age 13, the measure was the number of years of science studied in grades 7 and 8.

Indicators of out-of-school or informal science learning participation were derived from three questions dealing with the extent to which students have done or experimented with science or science-related things. The name of the scale, the number and type of items included, and a sample item are listed below.

1. Experimented With Things (8 Yes-No items)
   "Have you worked or experimented with sound?"

2. Informal Science Activities (8 Likert-type items)
   "How often have you watched science shows on TV when not required for science classes?"

3. Done Science-like Investigations (7 Yes-No items)
   "Have you ever collected leaves or flowers or insects?"

Each of these scales was included in a different test booklet. Analyses were conducted for the approximately 2,000 students who responded to each scale. In addition, a total out-of-school participation score was created by summing across the 23 items. Scores are reported as the number of activities done by students divided by the total number possible.

Sample

The science assessment selected respondents at each age level using a stratified, two-stage probability sample to ensure proportional representation by region of the country, sex, ethnicity, and size and type of community. The first stage of the sampling involved dividing the U.S. into primary sampling units consisting of geographic groupings with a minimum population size requirement. These primary sampling units were stratified according to four regions (Northeast, Southeast, Central, and West) and five sizes of community (ranging from cities of more than 200,000 population to extreme rural areas of less than 10,000 population). Sixty-four primary sampling units were drawn with probabilities proportional to size to represent all regions and community sizes. Oversampling was done in low-income urban areas and extreme rural areas to ensure adequate representation of these groups.

In the second stage of sampling, 125 schools were randomly chosen with probabilities proportional to the size of the school. Finally, a random sample of approximately 16 students (called a replicate) was selected from each school. Because of the random selection process, some schools were chosen more than once to receive a replicate, but no students answered more than one test booklet.

Defining Rural Schools and Selecting a Comparison Group

NAEP uses a poststratification system to describe the size and type of schools involved in the assessment. The classification is derived from information on community size and parental occupation provided by principals. There are four size classifications: big city (more than 200,000 population), urban fringe (urban areas of large cities), medium city (between 25,000 and 200,000), and small place (less than 25,000). The percentage of parents involved in various occupational categories is used to further subdivide the big city and small place groups. For example, low metro is a classification of students attending schools located in big cities with a high proportion of unemployed and low percentages of professional and managerial occupations.

Of interest in the present study is the small place category. This is defined as schools located in open country or a city with a total population less than 25,000. In addition, the city must not be in the urban area of a big city.

Our initial plans were to use the small place category as the operational definition of a rural area. However, we discovered that approximately 40 percent of the 17-year-old students in the NAEP samples attended schools in areas defined as small place. This seemed too large a proportion for the purposes of our research. We calculated the average grade size of the small place schools and obtained a figure of 203 students per grade with an average of 4.6 grades per school. This yields an average school size of 934 pupils which was contradictory to our conception of a rural school.

Based upon this analysis, we decided to use a school classification category based upon size and type of community. It is a subset of the small place group called extreme rural. These are sample schools located in communities of less than 10,000 population and with a relatively high percentage of persons employed in agriculture and relatively low percentages in professional, managerial, and blue collar occupations. Each school was assigned a rural index based upon size and percentage of farm workers in the community. Schools were than ranked in descending order on this index with cumulative sample size recorded. The schools that comprised the first 10 percent of the total sample size were defined as extreme rural. The remainder of the small place group, about 30 percent of the sample, was called small city in our study.

It must be noted here that the 1982-83 assessment included mathematics and social studies as well as science. The above classification was used for the total sample, not for each subject area. That is, 10 percent of all the schools in the assessment were labeled as extreme rural. However, there were variations across the three subjects and the age levels. In actual practice, 8.3 percent of the 17-year-olds and 10 percent of the 13-year-olds participating in the science part of the assessment were classified as extreme rural.

There is disagreement on what constitutes a rural school because of the great diversity of schools in this country. To some, it is a farm community in Iowa, to others it is a fishing village in Maine, or a coal company town in Appalachia. We were limited in our choice by the nature of the data base with which we chose to work. Although we retained the general sense of small community and low population density, some of the rural communities envisioned by some observers may not be included by our focus on farm workers.

Another issue which needed resolution was the selection of an appropriate comparison group. Although NAEP identifies seven different size and type of community categories, a seven-way comparison seemed too complicated and beyond the purposes of the study. Furthermore, the category sample sizes became relatively small when working with a single test booklet especially when using a two-way classification system, for example, rural students in the Midwest.

Other problem areas were the generally lower achievement scores of students classified as extreme urban and small city. Initially, our thought was to compare rural students with those in urban and suburban areas. However, we noted that the extreme urban scores were much lower than those in the other city categories, and we considered deleting them from the study. Upon further reflection, this seemed inappropriate because deleting them would spuriously inflate the magnitude of scores in the remainder of the comparison group.

We ran a number of comparisons between extreme rural (recall this is about 10 percent of the sample) and the remainder of the small place category, which we called small city (about 30 percent of the sample). No significant differences were found although extreme rural students tended to score lower on science achievement and report less participation in science learning activities. (Some contrary results were found for students living in the Central region. See Appendix A, which reports on science education in Midwest rural America.)

Based upon the foregoing analysis, a decision was made to compare the performance of extreme rural students with those attending schools located in communities with populations greater than 25,000. The comparison group was called nonrural in this study. Because of the rural nature of the small city category (localities having populations between 10,000 and 25,000 and scoring lower on the rural index), we decided to report their results as well, but not to include them in our statistical comparisons.

Results

Because of the nature of the multistage sampling plan, NAEP recommends the use of a design effect when testing the statistical significance of findings. They suggest dividing the degrees of freedom by a factor of two to compensate for the increased probability of finding significant results, which arises from the sampling process. This recommendation was followed in the current study.

Because our expectation was that rural students would score lower than nonrural, we used a one-tailed test. The significance level was set at .05.

Table 1 reports the extent of participation in science learning opportunities of 17-year-old students in three sizes and types of communities, extreme rural, small city, and nonrural. T-tests were conducted of the differences between the extreme and nonrural groups, and significant differences were noted with an asterisk. Small city results were reported for information purposes but were not included in the statistical comparisons.

Results were shown for three different measures of informal or out-of-school activities, a total participation score derived by summing across the three booklets, and for semesters of science taken in grades 9-12. Informal participation was expressed in terms of the percentage of possible activities done, and course taking was reported as the mean number of semesters studied of general science, biology, chemistry, and physics.

Table 1 indicates that students living in extreme rural America, as we have defined it in this study, report less opportunity to learn science than their large city counterparts. They are less likely to have experimented with things, or participated in informal science activities such as hearing talks on science, or read books about science or scientists. Furthermore, they have taken fewer science courses in high school, an average of one-half semester less.

Students in extreme rural communities had fewer opportunities to learn science than those living in small cities; however, these differences were generally quite small.

Because there is a positive relationship between science participation and science learning, one might think at first glance that these results might partially explain the poorer performance of rural students during national assessments conducted during the 1970s. However, the results shown in Table 2 tend to complicate the matter somewhat.

Table 1

Participation in Science Learning Opportunities
17-Year-Olds in Rural and Nonrural Schools
Means[1] and Sample Sizes

Participation Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Experimented with things (8 yes-no items)	58.3 (127)	57.8 (714)	61.8 (1199)	-3.9
Informal science activities (8 Likert items)	37.2 (188)	38.6 (604)	41.0 (1164)	-3.8*
Science-like investigations (7 yes-no items)	70.3 (174)	68.9 (596)	70.3 (1238)	0.0
Total activities done	54.5 (489)	55.2 (1914)	58.0 (3601)	-3.5*
Semesters science taken	3.30 (660)	3.51 (2532)	3.77 (4782)	-0.47*

[1]Means are percent of total possible except for semesters of science.
*Significant at the p = .05 levels.

Table 2

Science Achievement
17-Year-Olds in Rural and Nonrural Schools
Mean Percent Correct and Sample Sizes

Dependent Measure	Extreme Rural	Small City	NonRural	Extreme Nonrural
Booklet S20 (73 items) Content, Inquiry, STS	64.1 (170)	64.2 (616)	64.0 (1179)	0.1
Booklet S21 (49 items) Inquiry, STS	68.1 (187)	68.8 (605)	67.8 (1164)	0.3
Booklet S22 (49 items) Content, STS	61.8 (173)	62.5 (596)	60.6 (1237)	1.2
Booklet S23 (35 items) Inquiry, Content	61.1 (126)	63.5 (714)	64.6 (1197)	-3.5*
All items (I=206) Weighted average	64.1 (656)	65.9 (2523)	64.6 (4747)	-0.5

*Significant at the p = .05 level.

There were no statistical differences between the scores of students living in extreme rural areas and those living in larger cities. Only on booklet S23 did rural students fall behind, but because they were slightly higher on three of the four booklets, the overall difference was only -0.5 percentage points on the 206 items. In spite of fewer opportunities to learn science, rural 17-year-olds scored about as well as students attending schools in cities with populations of more than 25,000.

Extreme rural students scored lower than those in small cities but the differences were small. Students in the small city category scored higher than both groups when all of the items are considered, but these differences would not reach the .05 level of significance.

A similar analysis was conducted for 13-year-old students using the same dependent variables. Table 3 reports results for participation in science learning activities. The findings were similar to those for 17-year-olds. In fact, the discrepancies were greater. Students attending schools in rural areas did not participate in as many informal or out-of-school activities and they tended to take fewer science courses in the seventh and eighth grades. Significant differences were found on each of the scales except for the one dealing with informal science activities, for example, watching science programs on television.

Participation scores of students living in small cities fell between those of their smaller and larger city counterparts, suggesting that degree of ruralness may be a factor in science participation. However, statistical tests of these differences are not reported.

Table 4 reports achievement score differences for the groups. On two of the four tests, the extreme rural students scored significantly lower. However, the overall discrepancy of -1.9 points was not statistically significant.

Although the overall achievement differences were not significant, each of the six major comparisons noted in this study favored the nonrural students. They reported more science learning opportunities and scored slightly higher on the science achievement items. What is perhaps most surprising is the small achievement differences given the fairly large discrepancies on the participation measures.

Concluding Remarks

This study examined the science participation of students living in rural America and found they have fewer opportunities to learn science both in class and through informal or out-of-school activities. This discrepancy is particularly noteworthy for 13-year-old students. However, in spite of fewer learning opportunities, rural students tend to learn nearly as much science content as their larger city counterparts.

This finding is surprising given that there is a positive relationship between opportunity to learn and actual learning. Because rural students have fewer opportunities to learn, one might expect even greater discrepancies in science performance than found in the present study.

Although the present study does not include information necessary to explain these somewhat surprising findings, some factors which seem worthy of further investigation are mentioned below.

Table 3

Participation in Science Learning Opportunities
13-Year-Olds in Rural and Nonrural Schools
Means[1] and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Experimented with things (8 yes-no items)	45.1 (178)	48.1 (542)	50.8 (1266)	-5.7*
Informal science activities (8 Likert items)	40.9 (272)	41.0 (560)	43.5 (1194)	-2.7
Science-like investigations (7 yes-no items)	58.6 (170)	62.9 (552)	65.1 (1214)	-6.5*
Total activities done	47.0 (620)	50.6 (1654)	53.2 (3674)	-6.2*
Years science taken	1.52 (786)	1.67 (2170)	1.67 (4914)	-0.16*

[1]Means are percent of total possible except for semesters of science.
*Significant at the p = .05 level.

Table 4

Science Achievement
13-Year-Olds in Rural and Nonrural Schools
Mean Percent Correct and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Booklet T20 (73 items) Content, Inquiry, STS	52.9 (166)	58.3 (516)	56.7 (1240)	-3.8*
Booklet T21 (53 items) Inquiry, STS	56.4 (272)	56.9 (560)	57.2 (1194)	-0.8
Booklet T22 (49 items) Content, STS	48.6 (170)	52.4 (552)	50.7 (1214)	-2.1
Booklet T23 (35 items) Inquiry, Content	50.5 (178)	51.8 (542)	53.7 (1266)	-3.2*
All items (I=210) Weighted average	52.6 (786)	54.8 (2170)	54.5 (4914)	-1.9

*Difference significant at (p = .05) level.

It may be that families living on farms or in small communities have a greater commitment to learning and their children spend more time at it. Perhaps rural children do not skip school as often or perhaps they spend more time doing homework, an important factor in learning (Fraser, Welch, and Walberg, 1986). Both of these factors may compensate for the inequities noted earlier in science participation. Although it was not done in the present study, the NAEP data base does contain information which could be used to test these and other hypotheses.

The environment of rural students may be more conducive to learning both in the home and in the classroom. Closer social relationships may develop that promote more cooperative learning, and smaller classes may also compensate for fewer science course offerings and less involvement in out-of-school science activities.

Further research is needed to examine these and other explanations for the relative success of rural children in the learning of science. However, the problem of inequity still remains. If rural children were provided with opportunities to learn science that were equal to those available to nonrural children, perhaps their science performance would exceed that of children attending schools in large communities.

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Appendix A

Science Education in the Rural Midwest

A study similar to the one reported above was carried out to examine the status of science education in the rural midwest. This study was implemented in response to special needs of the North Central Region Educational Laboratory (NCREL).

The problems of this study were to determine:

1. the extent of participation in science learning activities of midwestern rural students compared to students in larger midwestern schools

2. the science achievement of students in midwestern rural schools compared to students in other schools

The definition of Midwest used here follows from the NAEP classification of Central states. It includes the 12 states of Iowa, Kansas, North and South Dakota, Minnesota, Missouri, Illinois, Indiana, Michigan, Nebraska, Wisconsin, and Ohio. This is larger than the seven-state NCREL region, but was the region chosen for investigation because of the size of the sample available.

The Central or Midwest region, as we are calling it in this study, contains about 28 percent of all NAEP respondents. This is approximately 2,200 students at each age level. Our definition of rural, called extreme rural by NAEP, is about 10 percent of that sample. This provides us with about 220 rural students across the 12-state region, a number which we felt was already quite small. In fact, when conducting analyses on one of the four single test booklets, our sample sizes for extreme rural in the Midwest dropped below 50 in some cases. We decided not to reduce the size further by limiting the study to the seven-state region serviced by NCREL.

The procedures followed in the midwest study were identical to those used in the national study. In addition, results are reported in the same manner, a set of four tables comparing rural and nonrural participation and achievement for 17- and 13-year-olds.

Results

At age 17, midwestern rural youth reported less participation in science learning experiences. The differences were most pronounced in the number of semesters of science courses taken. These students had only studied 2.93 semesters of science in grades 9-12, about 3/4 of a semester less than students attending schools in larger cities. However, in spite of fewer opportunities to learn science, they scored equally well on science achievement items. (See Table A1 and Table A2.)

Table A1

Participation in Science Opportunities
17-Year-Olds in Midwest Rural and Nonrural Schools
Means and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Experimented with things (8 yes-no items)	61.8 (52)	57.8 (179)	66.3 (357)	-4.5
Informal science activities (8 Likert items)	37.4 (80)	34.5 (172)	39.8 (348)	-2.4
Science-like investigations (7 yes-no items)	78.7 (58)	71.3 (172)	72.3 (310)	6.5
Total activities done	56.7 (190)	54.6 (523)	59.0 (1015)	-2.3
Semesters science taken	2.93 (232)	3.30 (748)	3.65 (1374)	-0.72*

*Significant at the p = .05 level.

Table A2

Science Achievement
17-Year-Olds in Midwest Rural and Nonrural Schools
Means and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Non-Rural	Extreme Nonrural
Booklet S20 (73 items) Content, Inquiry, STS	65.4 (43)	64.4 (223)	68.0 (359)	-2.6
Booklet S21 (49 items) Inquiry, STS	69.1 (81)	68.9 (173)	66.9 (348)	2.2
Booklet S22 (49 items) Content, STS	65.6 (58)	65.1 (170)	62.7 (310)	2.9
Booklet S23 (35 items) Inquiry, Content	64.1 (52)	63.8 (179)	67.1 (355)	-3.0
All items (I=206) Weighted average	66.4 (234)	65.5 (744)	66.2 (1373)	0.2

Small city students participated in fewer out-of-school activities than the extreme rural group, but they took more science courses in high school. These students scored slightly below the rural group on science achievement.

The booklet-to-booklet fluctuations on the measures of science experiences were quite large, ranging from a -4.5 to +6.5. However, the standard errors were greater due to the small sample sizes, and these differences did not reach statistical significance. (See Table A3 and Table A4.)

At age 13, in spite of fewer science learning opportunities outside of the schools, -10.3 for all activities, the midwestern students scored higher than their large city counterparts on science achievement items. Although the 2.1 point difference was not statistically significant, it was the largest achievement score difference noted in this series of studies. Years of science taken by the 13-year-olds in junior high school were the same for the extreme and nonrural group.

The results for the midwestern study tended to mirror those found in the national study. Students attending schools in rural areas did not participate in as many science learning activities. However, these discrepancies did not seem to have penalized the students on measures of science achievement. At both age levels, midwestern rural students slightly outperformed the nonrural group. However, the probability that these differences were due to chance variations exceeded the .05 level of significance using a one-tailed test.

Table A3

Participation in Science Learning Opportunities
13-Year-Olds in Midwest Rural and Nonrural Schools
Means and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Experimented with things (8 yes-no items)	48.0 (52)	50.3 (124)	53.8 (338)	-5.8
Informal science activities (8 Likert items)	41.5 (98)	43.2 (120)	44.4 (346)	-2.8
Science-like investigations (7 yes-no items)	61.3 (16)	67.1 (164)	69.0 (352)	-7.7
Total activities done	45.5 (166)	55.0 (408)	55.8 (1036)	-10.3*
Semesters science taken	1.72 (192)	1.56 (566)	1.70 (1404)	0.02

*Significant at the p = .05 level.

Table A4

Science Achievement
13-Year-Olds in Midwest Rural and Nonrural Schools
Means Percent Correct and Sample Sizes

Dependent Measure	Extreme Rural	Small City	Nonrural	Extreme Nonrural
Booklet T20 (73 items) Content, Inquiry, STS	63.4 (26)	59.2 (158)	58.0 (368)	5.4
Booklet T21 (53 items) Inquiry, STS	59.1 (98)	59.4 (120)	58.1 (346)	1.0
Booklet T22 (49 items) Content, STS	51.9 (16)	55.2 (164)	53.2 (352)	-1.3
Booklet T23 (35 items) Inquiry, Content	55.4 (52)	54.8 (124)	54.6 (338)	0.8
All items (I = 210) Weighted average	58.1 (192)	57.1 (566)	56.0 (1404)	2.1

Concluding Remarks

This supplementary study examined the differences in science participation and achievement for students living in the rural midwest. The results were similar to those found in a national study of rural science education. Although rural students of both ages 13 and 17 did not participate in as many science learning activities, their science achievement scores were similar to those attending schools in larger cities.

A first glance, it would appear that other factors may be compensating for the lack of learning opportunities among these students, for example, amount of homework or perhaps school attendance. There may also be some school or family environmental influences that could explain the results.

An alternative, but seemingly unlikely, explanation might be that participation in science learning activities is negatively related to science achievement. Such an analysis was carried out, but only on a single booklet and using only science courses studied. Course taking correlated .23 with achievement for 13-year-olds (Fraser, Welch, and Walberg, 1986) and .31 for 17-year-olds (Walberg, Fraser, and Welch, 1986). An unpublished study found a correlation of .16 between out-of-school science participation and achievement (Welch, 1985) on booklet S22.

What might be informative is a study where the degree of ruralness is included with a number of other variables that partially explain science achievement. This would enable us to compare the relative influence of attending a rural school with such variables as amount of homework, quality of instruction, motivation to learn, and parental occupation. The effect of ruralness could be tested while holding other predictors of science achievement constant. The NAEP data set would make such a study possible.

An additional line of inquiry might pursue the nature of the rural schools used in this investigation. How large were they? Perhaps school consolidation has essentially eliminated a truly rural school. How does course-taking behavior in mathematics compare with that in science? What attitudes toward science are held by children in rural schools? What are the characteristics of teachers in the various size schools? Here, again, the national assessment data are available for secondary analysis and investigation of these problems. Researchers interested in better understanding the condition of rural education would be well-advised to consider this information source in their future investigations.